

REMARKS

The Office Action dated May 22, 2003 has been received and carefully noted. The above amendments to the specification, drawings and claims, and the following remarks, are submitted as a full and complete response thereto. No new matter has been entered through these amendments.

The drawings were once again objected to for various reasons identified in the Office Action. Replacement figures are included herewith in response to those objections. Former Fig. 1a has been removed, former Fig. 1b has been relabeled as "Fig. 1", the legend "Prior Art" has been added to Fig. 2, and Fig. 5 has been amended per the Examiner's suggestion. An annotated copy of the drawing sheet containing Fig. 5 is also enclosed as an appendix to this Response, to point out the particular changes to Fig. 5. Applicants respectfully assert that the objections to the drawings have been addressed and the objections should now be withdrawn.

Claims 15-27 were rejected under 35 U.S. C. §112, second paragraph, as being indefinite. Claim 15 has been amended to more particularly point out and claim the present invention. It is acknowledged that the Examiner encouraged the substitution of "associated with" for "produced by" in claims 15-27, but it is hoped that the changes to claim 15 make clear that both of the primary and secondary windings produce magnetic fluxes and that the suggested change to the claims would not make the claims clearer.

The Office Action has also again alleged that claims 15 and 17 are in apparent conflict. Applicants respectfully note that the fluxes and their directions as recited in the

claims seem to be a cause for confusion. In an effort to clear up this apparent confusion, applicants have included a somewhat simplified Exemplary Figure. The Exemplary Figure illustrates that the primary and secondary windings produce two resulting fluxes: resulting flux 1 and resulting flux 2. the filter coil produces flux 3. As can be seen in the exemplary figure, the resulting flux 1 in the side leg MS1 flows in the same direction as the resulting flux 2 in the side leg MS2. Further, the resulting flux 1 and the resulting flux 2 both flow in the same direction as flux 3 in the center leg. It is hoped that the changes made to claim 15 herein assists in providing clarification.

In more detail and referring to amended Fig. 5, it is noted that footnote A refers to the time interval t_0 - t_2 and footnote B to the time interval t_2 - t_4 in the specification. During time interval t_0 - t_2 the primary winding P_1 in side leg MS1 produces flux Φ_{B1} , and the secondary winding S1 produces a flux Φ_{A1} which is opposite in direction to flux Φ_{B1} , as recited in claim 17. Yet, because of how the windings, and particularly their winding directions, are arranged, the resulting flux is in the direction of Flux 1 in the enclosed Exemplary Figure. Thus, claims 15 and 17 do not conflict. Rather, claim 17 merely provides a more detailed recitation of the arrangement of claim 15.

Additionally, the Office Action also makes reference to claims 24 and 26 reciting "the first side" and "the second side" without proper antecedent basis. However, neither claim recites either "the first side" and "the second side", so that Applicants do not understand the basis of the alleged rejection of claims 24 and 26. Applicants respectfully

assert that claims 15-27 are definite under 35 U.S.C. §112 and request that the rejection of the claims should be withdrawn.

The Office Action also made several rejections of the claims over prior art. Claims 15, 17 and 28 were rejected under 35 U.S.C. §102(b) as being clearly anticipated by *Cielo et al.* (U.S. Patent No. 3,694,726). Claims 15, 17, 24, 26 and 28 were rejected under 35 U.S.C. §102(b) as being clearly anticipated by *Bloom* (U.S. Patent No. 4,864,478 or 4,961,128). Claims 16, 18-20 and 21 were rejected under 35 U.S.C. §103(a) as being unpatentable over either *Cielo et al.* or *Bloom*. Claims 22 was rejected under 35 U.S.C. §103(a) as being unpatentable over either *Cielo et al.* or *Bloom* in view of *Barrett* (U.S. Patent No. 5,737,203). Claims 23 was rejected under 35 U.S.C. §103(a) as being unpatentable over either *Cielo et al.* or *Bloom* in view of *Morris* (U.S. Patent No. 5,555,494). The above rejections are respectfully traversed according to the remarks that follow.

The present invention is directed to, as embodied in independent claim 15, a chopper-type direct-current converter. The converter includes a magnetic core, which has a first and a second side leg, the ends of which are connected to each other with end pieces, and a center leg provided with an air gap and connected to the end pieces between the first and second side legs. Around the magnetic core are arranged a primary winding, a secondary winding and a secondary side filter coil. The filter coil is wound around the center leg and the primary and secondary windings are wound around the side legs so that the resulting magnetic fluxes produced by the primary and secondary windings flow in

the same direction on the side legs, and so that the magnetic return flux flows in the same direction on the center leg as the magnetic flux produced by the filter coil.

The present invention is also directed to, as embodied in independent claim 28, a chopper-type regulator. The regulator includes a magnetic core, which includes a first and a second side leg, the ends of which are connected to each other with end pieces and a center leg provided with an air gap and connected to the end pieces between the first and second side legs. Around the magnetic core are arranged two windings and a filter coil. The filter coil is disposed around the center leg and the windings are disposed around the side legs so that the magnetic flux produced by them flow in the same direction with the magnetic flux of the filter coil.

Applicants respectfully assert that the above referenced magnetic fluxes provided by the various windings and their directions are what constitute an important aspect of the present invention. Applicants respectfully assert that both *Cielo et al.* or *Bloom* fail to teach or suggest such an arrangement.

Cielo et al. discloses a typical push-pull DC-DC-converter that has an integrated magnetic component. *Cielo et al.* discloses two different solutions to provide maximum efficiency for the converter. In the first solution (fig 1), the primary windings operate in the alternating shifts around their own side legs. The phases of the secondary windings are so arranged that the load current is coupled to the secondary winding around the different side leg than the primary winding. The sum flux of the primary and secondary currents stores energy into the air gap during the active state of the one of the two

transistors. This energy discharges between the active states through one diode (D3) to the load. The disadvantage of this solution is the poor coupling between the primary and secondary winding, which decreases the energy coupling and increases the energy of the stray inductance. This in turn can be seen as a high voltage peaks on the collectors of the transistors when the primary current is turned off.

The second solution by *Cielo et al.* tries to solve the above described problems of the first solution. The second solution is known as a current coupled push-pull topology that is well known in the art. In this solution the energy is stored into the air gap using ^athe different principle than in the first solution. The primary current flows always through winding N4 whenever the other of the two transistor is in active state storing the energy that discharges through winding N3 and diode D3 between the active states of said transistors.

The present invention, on the other hand, is directed to a chopper-type direct current converter that comprises a magnetic core that further comprises a first and a second side legs, the ends of the which are connected to each other with end pieces, and a center leg provided with an air gap and connected to the end pieces between the first and the second side legs around which magnetic core are arranged. The filter coil is disposed around the center leg and the primary and secondary windings are disposed around the side legs so that the magnetic flux produced by the primary and secondary windings in the center leg flows in the same direction as the magnetic flux produced by the filter coil.

The advantages of the claimed invention include the fact that the power source can be designed around a single standard type magnetic core. This allows considerable advantages to be achieved both in design and in manufacture. The solution presented allows more effective utilization of the capacity of the magnetic flux density. Reducing the number of separate filter coils decreases the size of the power source and therefore improves its power density. At the same time, the magnetic core can be relatively effectively utilized. In large production quantities, significant cost savings in core material are achieved.

All of the solutions above have certain common aspects. The primary goal to achieve is an isolated DC-DC converter using an integrated component that has both transformer and coil. Also each of them has an E-type core with three legs, primary and secondary windings arranged around the side legs and one or two windings around the center leg. However, in the present invention the electrical function of the coupling is different than in ^{the} prior art. As such, Applicants respectfully assert that the rejection of independent claims 15 and 28 are improper for failing to teach or suggest all of the elements of those claims.

Similar to the above discussion regarding *Cielo et al.*, *Bloom '128* discloses two-stage, current-coupled, switched-coil buck pre-regulator power-part topology followed by a 50% / 50% isolating push-pull stage. Applicants respectfully assert that the principle discussed in *Bloom '128* is itself known and has been commonly used. The isolating push-pull stage uses the side legs of a magnetic circuit as if one leg was a push-converter

for one half-cycle, and the other leg was a push-converter for the other half-cycle. Even assuming such a configuration works as disclosed, it is disadvantageous when compared to a standard E-type ferrite core in which the cross section of the center leg is twice that of the side legs.

In the configuration of *Bloom '128*, if the primary and secondary windings of a converter are located on the center leg, their return flux will be divided to the side legs in half. However, if the windings of a converter are located on the side legs, the total flux will have to pass via a side leg. Applicants respectfully assert, however, that the disclosure of *Bloom '128* has little relevance to the present invention, as discussed with respect to *Cielo et al.* above.

Additionally, *Barrett* and *Morris* were cited in the rejection of claims 22 and 23, but those references do not teach or suggest the configuration of elements provided in independent claims 15 and 28. Similarly, the rejection of claims 16-27 should likewise be improper for at least their dependence on claim 15. Applicants respectfully request reconsideration and withdrawal of all of the rejections, that claims 15-28 be allowed and that the application be allowed to pass to issue.

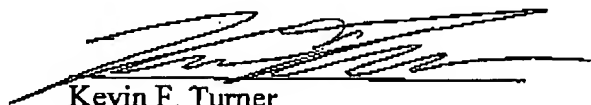
Lastly, Applicants also acknowledge that the Office Action recommended that "details of a chopper-type direct-current converter or chopper-type direct-current regulator . . . be added to the claims." However, Applicants respectfully asserts that the magnetic structure recited in claims 15 and 28 is sufficient to particularly point out and distinctly claim the invention as required by U.S. patent law and that further limitations

related to details of chopper-type direct-current converter or chopper-type regulator are not needed.

If for any reason the Examiner determines that the application is not now in condition for allowance, it is respectfully requested that the Examiner contact, by telephone, the applicant's undersigned attorney at the indicated telephone number to arrange for an interview to expedite the disposition of this application.

In the event this paper is not being timely filed, the applicant respectfully petitions for an appropriate extension of time. Any fees for such an extension together with any additional fees may be charged to Counsel's Deposit Account 50-2222.

Respectfully submitted,



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Enclosures: Amended Drawings
Exemplary Figure